J. CRAWFORD ADAMS

STANDARD ORTHOPAEDIC OPERATIONS

SECOND EDITION

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PREFACE

This second edition incorporates substantial improvements over the first edition published in 1976. Not only has there been a thorough revision of the existing text and illustrations in response to suggestions from readers and critics; but descriptions of 30 further operations have also been brought in, and there are over 150 additional illustrations.

The book is intended mainly for orthopaedic surgeons in training and for general surgeons who are from time to time confronted with orthopaedic problems. It may also be of use to those studying for the higher surgical examinations, to operation room nurses and technicians, and to orthopaedic nurses and physiotherapists who wish to gain an insight into orthopaedic techniques.

My aim has been to provide a more detailed description than is generally available of those routine operations that are commonly delegated to the junior man—operations that he may never have had the opportunity to carry out under supervision or that he may be undertaking alone for the first time. It is often in these standard procedures that the junior surgeon feels the need for guidance. In contrast, the more formidable operations, in which the junior surgeon may expect always to have the supervision of his chief, are covered in less detail or in some cases omitted altogether. The book was never intended to be entirely comprehensive, and it should be regarded as complementary to the major textbooks on operative orthopaedics rather than as a substitute for them.

In general, the emphasis has been on verbal description rather than on illustrations. Nevertheless there are many points that can be illustrated more easily than described, and much attention has been given to the selection of those illustrations—all simple line drawings—that seemed essential to clarify the text.

In a sense this is a personal book: I have tended to select those techniques which over the years I have found most satisfactory. This may be a fault in so far as certain well tried techniques may be found missing. I recognise, too, that there is often more than one way of carrying out a given procedure, and I would be the last to suggest that the methods that I have described are necessarily the best. Nevertheless I hope it may be the case that those techniques that have commended themselves to me over a long period may prove equally satisfactory to the next generation of surgeons.

The material in this book is derived overwhelmingly from my own experience and only very little directly from the published descriptions of other authors. Nevertheless on certain points of detail it has been necessary—and indeed proper—to refer to other sources, too numerous to mention individually here. When my description has conformed closely to that of a known originator the source has generally been quoted in the text. For tidiness these references are grouped together at the end of the book.

I am indebted to Mr Anthony Rollason for the anatomical drawings and to Mr John Pizer for help with many of the other illustrations; and it is a pleasure to acknowledge the help and courteous cooperation provided at all times by the publishers, Churchill Livingstone.

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INTRODUCTION

It is well to remember that the operation that the surgeon approaches as a matter of routine —often even casually—may for the patient be a major event of his life. He may have been dreading it for weeks beforehand. He may preserve an outward calm, but often he has a deep apprehension within—a fear of the unknown, a fear of pain, a nightmarish thought that he may be permanently disabled or even die. Unfortunately these qualms are not entirely groundless. Things do go wrong from time to time. Disasters occur: infection, paralysis, ischaemia, occasionally death. The incidence of such complications should indeed be slight, but the threat always exists.

Thus it behoves the surgeon, each time that he operates, to put himself for a moment in the position of the patient. Nothing must go wrong. Even the simplest of operations must be approached in a serious and professional manner. The first rule of surgery must always be foremost in the surgeon's mind—that the operation must not make the patient worse than he was before he submitted himself to it.

If the patient has to come back into hospital for a revision operation because the first one was carried out imperfectly, the surgeon has failed in his duty. Some years ago the author made a count of the patients in an orthopaedic ward to discover how many were there for a primary operation and how many had been readmitted for revision or salvage procedures after the previous operation had proved inadequate or had been marred by complications. It was daunting to find that no less than one in three of the patients fell into the second category. Regrettably, many revision operations are occasioned by errors that are wholly avoidable. The moral to which these observations point is expressed in five monosyllables: 'Get it right first time'.

How then is the best possible result to be achieved every time that the surgeon operates upon a patient? This question may conveniently be discussed under the following four headings: pre-operative assessment of the patient; planning of the operation; operative technique; and post-operative management.

PRE-OPERATIVE ASSESSMENT OF PATIENT

Even if the proposed operation is a relatively minor one it is important in every case to assess the patient thoroughly, not only from the point of view of the cardiovascular and respiratory systems but also with respect to any special feature that might make operation hazardous. It is these special features that often go unsuspected. For instance, in persons of African stock the presence of abnormal haemoglobin in sickle-cell disease may predispose to agglutination of red cells, especially in conditions of anoxaemia. In women taking contraceptive pills there may be a predisposition to venous thrombosis. In the elderly, anticoagulants used in the prevention or management of deep venous thrombosis may predispose to cerebral haemorrhage. A septic focus, even though it may be remote from the field of operation and consequently unnoticed, may rarely be a source of metastatic infection, especially if the wound is a major one and if foreign material such as acrylic cement or a prosthesis has been implanted. Again, generalised osteoporosis if unrecognised may lead to inadvertent fracture of a bone during the course of an operation—as in a case of the author's in which the shaft of the femur was fractured during the routine manoeuvre employed for reduction of a femoral neck fracture: it later emerged that the patient was suffering from osteoporosis consequent upon a parathyroid adenoma.

These are sufficient examples to indicate that time must be spent not only in routine examination of the various body systems but also in questioning the patient about any circumstance that might have a bearing on the safety of the anaesthetic or of the operation itself.

PLANNING THE OPERATION

When an operation fails to give the best possible result the failure may often be ascribed to inadequate planning of the procedure. A hurried assessment of the problem—seemingly perhaps a routine one—without a sufficiently detailed study of the clinical state and of the radiographs has often led the surgeon to undertake a particular operation whereas a more thorough analysis might have suggested the need for a different procedure. For instance, a high fracture of the femoral shaft might at first sight seem suitable for internal fixation by an intramedullary nail, and it may not become apparent until the nail is found to have cut through the soft bone of the greater trochanter that the proximal fragment was too short to afford sufficient grip for a plain nail: a signal arm device would have been a more appropriate means of fixation.

Another example may amplify the point. A fractured medial malleolus may be treated by screw fixation and all may seem well at first. But to the surgeon's surprise the patient returns later with marked lateral subluxation of the talus. More comprehensive radiographs then show that there has been a high fracture of the fibular shaft, denoting rupture of the inferior tibio-fibular ligament. Had the true nature of the injury been appreciated initially, the correct treatment would have been to hold the fibula to the tibia with a transverse screw.

If operation is being undertaken to correct a deformity, for instance by wedge osteotomy, it is essential that the degree of the deformity be accurately established by measurements, both clinically and radiologically, so that the amount of correction to be gained—the precise number of degrees—may be planned in advance. Here again the precept 'Get it right first time' is very relevant.

The advice that emerges from these considerations is that before each operation the surgeon should sit down quietly with a full knowledge of the clinical state of the patient and with the radiographs before him to decide whether or not the case is in fact suitable for the operation that he has in mind, and to plan in detail the best method of gaining the objective.

Marking the correct site for operation. Various methods have been suggested to ensure not only that the correct patient is operated upon but that the surgeon embarks on the operation on the correct side and at the correct site. Failure to take adequate precautions does lead from time to time to serious mistakes: cases are on record even of the wrong limb having been amputated. The author himself in his early days of training amputated the wrong toe following ambiguous instructions from his chief. Such accidents can be prevented with certainty in the following manner. The day before the operation the surgeon himself obtains from the patient his confirmation of the side affected and, in the case of digits, which particular digit or digits are to be operated upon. With an indelible skin pen an arrow is then marked boldly upon the skin surface close to the site of operation to indicate clearly the part that is affected. This procedure has been routine in the author's practice for many years and it effectively eliminates any possibility of error.

OPERATIVE TECHNIQUE

There is no doubt that manual dexterity as translated into operative skill is to some extent inborn, just as is an aptitude for music or for ball games. There are surgeons who never acquire more than a moderate technical proficiency. Others quickly show an aptitude that with appropriate training and practice evolves into such confident skill that the performance of an operation by such a master is a delight to watch. In orthopaedic surgery a natural flair for things mechanical is a valuable asset. A fondness for Meccano in youth has served many a surgeon in good stead, for just as Meccano is 'engineering for boys' so to a large extent orthopaedic surgery is engineering in bone, muscle and tendon.

No matter whether or not the young surgeon has a natural aptitude, however, he is unlikely to develop his skill to the full without extreme diligence, study and practical experience under the guidance of a master surgeon.

INSTRUMENTS AND EQUIPMENT

It is not appropriate here to attempt a full description or review of all the equipment available to the orthopaedic surgeon, or even to make selective recommendations. The range of equipment and instruments that are nowadays available is so vast that limitations of space alone would forbid a comprehensive review. Equally importantly, the trainee surgeon for whom this book is intended does not ordinarily have a free choice of the instruments that he will use: in general he must use those that are available in the particular hospital where he works.

Nevertheless it is important to emphasise that an operation should not be embarked upon unless all the apparatus that may be required is available. For instance, before undertaking a nail-plating operation for fracture of the trochanteric region of the femur the surgeon must ensure that a full range of nail-plates of all the standard lengths and angles is available. If a full range is not to hand it is better to defer the operation for a few hours and to send out urgently for further stock. Likewise it is foolhardy to undertake intramedullary nailing of a fractured femur or tibia unless a full set of power-driven reamers is available: hand-driven reamers are not adequate. The patient is entitled to expect that every unit where such operations are to be undertaken should be properly equipped for the purpose.

So far as powered tools are concerned certain items are necessities, others luxuries. The only powered tools that are essential for general orthopaedic work are a motor saw, a power-driven drill, and a slow-speed drive for medullary reaming. Among the luxuries—more and more regarded as 'essential' as surgeons become more sophisticated—are a high-speed drill with dental-type burrs, a reciprocating saw, and an acetabular reamer. Power-operated chisels and powered bone punches are still true luxuries.

Radiographic apparatus is standard equipment for an orthopaedic operation room. For certain operations two machines—one for antero-posterior and the other for lateral radiography—are mandatory. At present not every operation suite is equipped with a mobile image intensifier. It is possible to undertake most orthopaedic operations without one, reliance being placed upon radiographic films: nevertheless in the operative treatment of fractures of the major long bones the saving of time from the use of an image intensifier is so considerable that in any large accident unit it must be regarded as an essential piece of equipment.

If the surgeon is fortunate enough to have a free choice of equipment he will have to make his selection from a very wide range. He will also have to decide whether to use cobalt-chrome alloy, stainless steel or possibly titanium for his implants. Many patterns of screw, plate, nail and nail-plate are available—most of them entirely adequate for their purpose. The range of fixation devices offered by the Swiss school of surgeons forming the "A.O."* group is out-

*"Association for Osteosynthesis"

standing for its precision and versatility, though the cost may often be a bar to its adoption as standard equipment.

Good equipment helps; it helps enormously. But in no way does it make up for poor surgical technique. A competent surgeon equipped with only the simplest of tools will enjoy far better results than his ham-fisted colleague who may be equipped at ten times the cost.

SETTING UP FOR THE OPERATION

In orthopaedics more than in most branches of surgery setting up the patient for the operation is of vital importance, and the surgeon who supervises this himself will be well rewarded. Even minor details such as the position of a tourniquet and the pressure to which it is inflated, the position of a limb in respect of postural pressure upon nerves and blood vessels, and the proper placing of the diathermy leads should always be watched. Nothing should go unchecked.

If the patient is to be positioned on the orthopaedic table—as for nailing of a fracture of the neck of the femur—the personal supervision of the surgeon is essential: there are so many points of detail to be considered that delegation of this responsibility is most unwise unless an assistant of exceptional experience and skill is available. The surgeon should also himself check the positioning of the radiographic units or image intensifier; otherwise the time will surely come when he calls for a radiograph, only to find that centering of the beam has been imperfect and that in consequence the film fails to show the essential part.

These remarks apply also to setting up the patient and the apparatus for intramedullary nailing of a fractured long bone. One difficulty here is to position the patient in such a way that easy access is afforded for reduction of the fracture and for insertion of the nail, and at the same time that the limb is accessible for radiography with the image intensifier. In these cases special attachments fitted to the operation table to support the affected limb may prove very useful: examples are described in the relevant sections of this book.

THE USE OF TOURNIQUETS

The use of a tourniquet makes peripheral limb operations very much easier and more precise; and provided that proper precautions are observed the advantages far outweigh the potential hazards.

Types of tourniquet. Long departed are the days of the rubber tube and anchor tourniquet, now seen only in museums. Gone also should be the era of the rubber bandage (Esmarch) tourniquet, which is still found in use occasionally. The Esmarch rubber bandage survives, however, as a useful means of exsanguinating the limb before the occlusive cuff is applied or inflated.

Almost universally used nowadays is the pneumatic cuff tourniquet. The design of pneumatic tourniquets has improved markedly since the second world war, and whereas a sphygmomanometer cuff and mercury column will still serve the purpose, the preferred type now is the purpose-made cuff with automatic pressure-maintaining device operated from a small cylinder of liquid gas. With this machine, once the pressure is set at the desired figure the surgeon may operate in the confident knowledge that a sudden failure of the tourniquet—so common a mishap in earlier days—will not occur.

Applying the tourniquet. The important points in applying the pneumatic cuff are, first, that it should be applied in the correct position, and secondly, that it should be applied snugly. A pneumatic cuff may be applied directly to the limb, though some surgeons still prefer to use a protective layer of towelling, plastic foam or gamgee tissue beneath it. The correct sites of application are: in the thigh, high up, close to the groin; in the lower leg, at the thickest part of the calf; in the upper arm, a little above the mid-point of the arm, where the muscles are most bulky. All these sites are those where good muscle bulk acts to protect the underlying nerves. Applying a cuff where nerves are superficial and relatively unprotected—for instance, near the knee—entails a serious risk of nerve damage.

When the pneumatic cuff is being wrapped round the limb it is important that it be applied snugly, without too much slack. If the cuff is applied loosely it may not expand sufficiently on inflation to occlude the arteries.

Exsanguinating the limb. When the cuff has been applied—but not inflated—an Esmarch rubber bandage is applied from the periphery upwards, with moderate tension, to drive the blood in the small vessels proximally. The bandage is applied in spiral fashion, with hardly any overlap. It should extend right up to the lower edge of the tourniquet cuff.

Inflating the cuff. The tourniquet cuff is now inflated to the desired pressure, and immediately thereafter the rubber bandage is removed. The time at which the tourniquet was inflated is recorded.

The correct pressure for a tourniquet depends upon the arterial blood pressure in the limb: ideally the cuff pressure should be higher than this by 30 to 50 millimetres of mercury. Blood pressure is normally higher in the lower limb than in the upper; so a somewhat higher cuff pressure is needed. Naturally, the cuff pressure will need to be appropriately higher in hypertensive patients; in children, on the other hand, a relatively low pressure suffices. The recommended pressures as engraved on most proprietary tourniquet sets are considerably higher than the pressures usually needed: the surgeon's discretion should override these standard markings.

Safe duration of tourniquet compression. No clear-cut rule can be laid down concerning the longest time that a tourniquet should be allowed to remain inflated, though it is a reasonably safe working rule to suggest one hour for the upper limb and an hour and a half for the lower limb. Safety does not depend upon time alone: it depends largely upon the pressure of the cuff and the volume of muscle padding. In the early stages of tourniquet compression the danger lies not in ischaemia but in direct pressure upon nerves. The higher the tourniquet pressure, the greater does the risk of nerve damage become. A limb that is very thin is far more vulnerable to injury than one that is well covered with muscle or even with fat. Indeed, in a very thin person tourniquet compression for even half an hour may be sufficient to cause nerve paralysis, whereas in a big muscular individual compression for as long as two hours may be innocuous. The surgeon should thus use his judgement in each individual case, observing the general rule that an hour for the arm and an hour and a half for the lower limb are the outside maximum times allowable, and being prepared to reduce these times, especially if the limb is unduly thin or if an unusually high cuff pressure is required on account of hypertension.

After a tourniquet has been released and the blood allowed to flow for fifteen minutes it is safe to inflate the cuff for a second period, though this should not usually exceed half an hour for the arm and three-quarters of an hour for the leg.

The Esmarch rubber bandage tourniquet. If in exceptional circumstances the Esmarch tourniquet has to be used as an occlusive cuff—as distinct from an exsanguination bandage—it must be applied with special care, and certain precautions must always be observed.

A major drawback of this type of tourniquet is that the actual constricting pressure applied to the limb is unknown. Unless the bandage is applied intelligently it is almost certain that the pressure will be excessive. As a general rule, only three turns of rubber bandage applied at full strength by a man of moderate strength exert enough force to occlude the arteries. It is clear therefore that if the whole bandage is applied at full stretch a hugely excessive pressure is brought to bear on the limb: it may easily reach 600 millimetres of mercury or more. A bandage applied injudiciously with full force may bite into the tissues and do serious damage to nerves, and possibly also to arteries, especially if they are atheromatous. Indeed, because of the relatively small bulk of muscle to protect the nerves and vessels, it is recommended that the Esmarch tourniquet should never be used for the arm.

A further hazard with the Esmarch tourniquet is that, being often hidden from view and not connected by long tubes to a pressure gauge as is the pneumatic tourniquet, it may accidently be left on and forgotten. Such a disaster is likely to lead to amputation or even to death from tissue damage and consequent renal failure.

The following rules should therefore be strictly observed if this obsolescent type of tourniquet is used. 1) The tourniquet should be applied over a folded towel or cuff of felt or gamgee so that the pressure is evenly distributed. 2) The tourniquet should be applied only over bulky muscle. 3) No more than three turns of the rubber bandage should be applied at full stretch in the first instance: if these prove insufficient to occlude the arteries it is simple to reapply the cuff with a fourth turn. 4) The surgeon should himself routinely supervise the application of the tourniquet, and should personally ensure that the tapes that tie it in position are tied also to a part of the operation table as a precaution against the patient's being inadvertently removed from the table with the tourniquet still in position. 5) A responsible assistant should be detailed to report the tourniquet time every fifteen minutes. 6) The duration of compression should never exceed one hour.

Removal of tourniquet. As a general rule it is recommended that the tourniquet be removed before the wound is closed. Significant bleeding points may then be secured and the risk of the formation of a haematoma greatly reduced. It is true that many surgeons prefer to leave the tourniquet in position until the wound is closed as a matter of routine. But while this may make for neater and cleaner surgery, it is not a policy that can be endorsed. Disastrous haematomas resulting from failure to secure sizeable vessels before wound closure are admittedly rare, but they do occur: the author has seen two—one in the hand and one in the ankle region—in which the bleeding led to necrosis of the skin edges and prolonged morbidity. Even one such disaster is one too many, especially since it can so easily be prevented by the precaution of removing the tourniquet before closure.

Contra-indications to use of tourniquet. A tourniquet should not be used on a limb that shows evidence of ischaemia from atherosclerosis. It should be used cautiously, for the shortest time compatible with the needs of the operation, in cases of sickle-cell disease.

THE NON-TOUCH TECHNIQUE

Although the non-touch technique originated by Lane (1914) and advocated again by Fairbank (1942) has been widely abandoned the author believes that it embodies important precautions against inadvertent contamination of the wound. He still employs it himself and would like to see it readopted by orthopaedic surgeons as standard practice. On many occasions he has watched assistants and nurses contaminate their hands even in the process of donning gown and gloves: and if this misdemeanour is observed frequently it is obvious that it must be committed unobserved even more often. It was to allow for this kind of human failing that the non-touch technique was designed. Admittedly it is difficult to prove its efficacy in reducing the incidence of wound infection because so many other factors play a part; but the author is satisfied that it is a worth-while refinement. Moreover, once a surgeon has become accustomed to the technique he usually finds that it makes for neat surgery and adds little if anything to the operating time.

Details of the non-touch technique. Those who follow the non-touch technique assume that the gloved fingers are potentially contaminated and they therefore observe the principle that neither the fingers nor anything that has been touched by the fingers must ordinarily be allowed to enter the wound. If at a particular stage of the operation it becomes essential for the hand to enter the wound—as for instance in seating a prosthesis—a fresh over-sized glove is put on over the normal glove for the purpose. (Applying an over-glove is always safer than changing the gloves.) Swabs, packs, ligatures and suture materials are held only with forceps, never by the fingers. Only the point of each instrument is allowed to enter the wound, and that part of the instrument must never be touched by hand.

The instruments for an operation to be performed by the non-touch technique should be set out on a rectangular rather than a kidney-shaped trolley. The cloth draping the top of the trolley is demarcated into three longitudinal strips of about equal width. It is convenient to have the central strip coloured red, the outer strips being white or green. In laying out the trolley the instrument nurse places the handle of each instrument on one of the outer strips

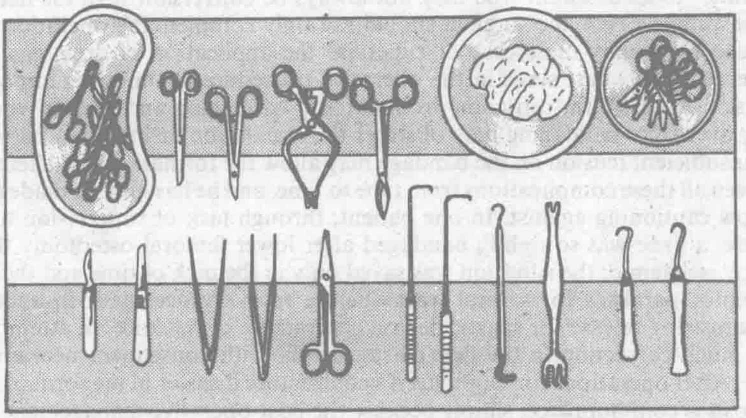


FIG. 1. Instrument table laid out for the non-touch technique. Only the handles of the instruments are touched: the "business ends" of the instruments rest on the central strip and must not be handled.

and the point rests upon the central strip (Fig. 1). The outer strips of the trolley cover may be touched by hand when instruments are taken from the trolley or replaced upon it, but the central strip is inviolable and must never be touched by hand or by any object that has been handled. After use, each instrument is returned immediately to its proper position on the instrument trolley: no instrument must be left lying about on the operation table or on the patient's body. The instrument nurse must learn to thread and present suture materials and ligatures by long forceps without ever handling them.

CLEAN AIR THEATRES

The development of "clean air" operation rooms in which the incoming air is filtered and rendered virtually free from bacteria has progressed rapidly since the first report of its use by Charnley and Eftekhar (1969) specifically for replacement operations upon the hip. Certainly the principle of operating in a bacteria-free environment has everything to commend it: the surprising thing is that introduction of the technique was so long delayed.

Operating in a clean air environment does however bring its own problems. The surgical team must be totally enclosed in "space suits" with an exhaust system for the expired air;

attendant difficulties of communication arise; and the technique is not easily adapted for operations that demand the use of radiological equipment.

At present clean air rooms are used almost exclusively for replacement surgery, but there can be little doubt that their use will be extended to include most major operations upon bone and joint. To some extent the method may be forced upon surgeons by medico-legal considerations.

POST-OPERATIVE MANAGEMENT

Post-operative management begins when the last skin suture has been inserted. In many centres the surgeon has already left the operation room long before this time, delegating what is a most important part of the treatment—the application of dressings, bandages and plaster-of-Paris splints—to an assistant who may not always be conversant with the details of technique. In the author's view the surgeon should not only complete the operation himself but he should also personally undertake or supervise the application of dressings and splints. In some operations this last stage in the operative procedure is almost as important as the operation itself. Much harm can come from careless bandaging and plaster work: position may be lost, over-tight bandaging may obstruct the circulation or imperil a nerve, or on the other hand insufficient tension on the bandage may allow the formation of a haematoma. The author has seen all these complications from time to time, and he has himself made the mistakes that he is now cautioning against. In one patient, through lack of supervision to the end of the procedure, a knee was so tightly bandaged after lower femoral osteotomy that the foot became partly ischaemic: the situation was saved only in the nick of time and the patient had to endure motor paralysis for several weeks before recovery occurred. In another patient treated by hamstring release for spastic flexion contracture of the knee an attempt was made to gain too much correction in the first plaster splint, with consequent neurapraxia of the sciatic nerve. After operations for Dupuytren's contracture disaster in the form of haematoma or skin necrosis is commonplace, simply because the post-operative management is defective. These are just a few examples of events that may go wrong. The important point to remember is that all such complications are avoidable—but only if the surgeon himself is aware of the hazards and takes the necessary steps personally to see that they are avoided. The young surgeon should always be prepared to learn from the mistakes of others; but he should try to ensure that he is not the model.

It is always wise to examine each patient a few hours after the operation in order to check the state of the circulation and of nerve function. Often a minor adjustment to the dressings or plaster at this early stage may save trouble later.

An important precept in post-operative management is that no patient should be confined to bed for longer than is really necessary. The greater proportion of orthopaedic patients should be able to get out of bed soon after the operation, and they should be encouraged to do so. If this is on the day of the operation itself so much the better. There are relatively few operations today that necessitate the patient's being kept in bed for more than a week or two, and with improvements in technique there are likely to be even fewer in the future. Early resumption of activity is particularly important in the elderly. It reduces the period of disability and it almost certainly discourages venous thrombosis and pulmonary embolism.

In this connection a brief reference is necessary to the question of sedation of the patient with analgesic and hypnotic drugs. In the author's view there is a prevalent tendency to over-sedate the patient immediately after operation, so that many hours elapse before he is allowed to "come round" sufficiently to appreciate what is going on. After orthopaedic operations heavy sedation is seldom required on account of pain—there are exceptions of course—and it militates against the early resumption of activity which is of such fundamental importance. The author much prefers that the patient be allowed to come round and to get going within a few hours of the operation.

In the early days after operation the assistance of a skilled physiotherapist is an important requirement, especially if a lower limb is the part affected. She is able to impart confidence to the patient and to teach correct methods of walking with crutches and sticks. Under skilled supervision a patient often achieves in a matter of minutes what he believed would be impossible in days or even weeks. Sound advice to a patient recovering from an orthopaedic operation is: "Don't just lie there; do something".

Chapter One

SOME SURGICAL APPROACHES

In most instances the surgical approach is included in the description of individual operations. Nevertheless there is a need here for a brief survey of the more important exposures, particularly of the deeply placed bones, joints and nerves. Limitations of space dictate that this shall be a selective rather than a comprehensive account.

ANTERIOR EXPOSURE OF SHOULDER

In the anterior approach to the shoulder the delto-pectoral groove is opened, the coracoid process is divided and reflected downwards with the attached muscles, and the subscapularis tendon is divided.

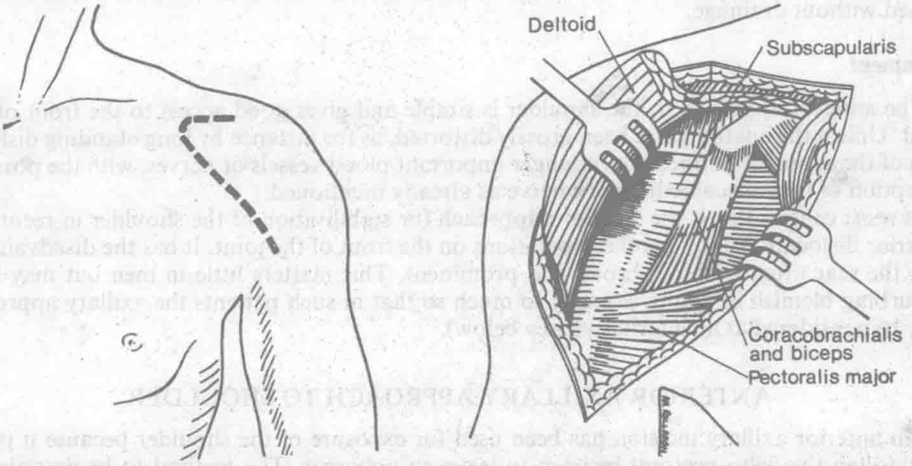
TECHNIQUE

Position of patient. The patient lies supine, with a firm sand-bag under the scapular region of the affected shoulder to thrust it forward. The whole arm is prepared and wrapped in sterile towels covered by a tube of stockingette. Separate draping of the limb in this way allows the surgeon and his assistant to manoeuvre the arm during the operation.

Incision. The main part of the skin incision, about 10 centimetres long, extends downwards and laterally from the coracoid process, following the medial edge of the deltoid muscle. At the proximal end it curves laterally close to the lower border of the outer end of the clavicle (Fig. 2). The skin edges are freed from the underlying deep fascia and held apart by retractors.

The deep dissection. The deep fascia is incised in the line of the skin incision and the cut edges are turned back in order to identify the delto-pectoral groove—that is, the junction between pectoralis major and deltoid muscles. This groove is marked by the large cephalic vein, which forms a useful landmark. As the two muscles are separated by blunt dissection the vein is retracted medially with the pectoralis major: a few small tributaries entering the vein from the outer side may need to be divided. When the two muscles have been separated in the lower part of the wound attention is directed to the upper part of the deltoid muscle where it is attached to the clavicle. The exposure is much enhanced if the medial part of the muscle origin is separated from the clavicle over a distance of 3 or 4 centimetres. This is best done by scissors after the muscle has been separated from the underlying tissues by blunt dissection: a small fringe of muscle should be left attached to the bone to aid reconstruction at the end of the operation.

The pectoralis major and the deltoid are separated as widely as possible with a self-retaining retractor, to reveal deep to them the coracoid process with the conjoined coracobrachialis and biceps (short head) muscles attached near its tip and passing vertically downwards into the arm (Fig. 3). The coracoid process is cleared of soft tissue at a point about a centimetre proximal to its tip. The distal part of the coracoid process is then separated with an osteotome. A holding stitch of strong catgut or silk is passed through the muscle origin immediately distal to the coracoid to allow the muscles to be reflected distally with the attached fragment of coracoid process. Before the muscles can be reflected adequately the fascia that fans out from each side of the muscle origin and from the coracoid must be divided and the borders of the conjoined muscles clearly defined. As the muscle mass is peeled downwards a few snips with scissors on its deep aspect free slender bridges of areolar tissue. At this point care must be taken not to damage the musculocutaneous nerve, which enters the deep surface of the conjoined muscles. The nerve, which is surprisingly large, must be identified as it passes downwards and laterally from the axilla to enter the coracobrachialis about 7 or 8 centimetres below its origin. Downward reflection of the muscle must cease when the entrance of the nerve into the muscle is revealed: attempts to reflect the muscle further may lead to stretching of the nerve.



FIGS. 2–3. Anterior exposure of shoulder. Figure 2—The skin incision. The horizontal limb of the incision may be omitted if only limited access is required. Figure 3—After separation of the deltoid and pectoralis major the conjoined coracobrachialis and biceps muscles are seen attached to the coracoid process. Deep to them lies the subscapularis, the fibres of which become tendinous as they approach their insertion into the humerus. The broken line shows the position of the head of the humerus.

When the coracoid process and the attached muscles have been reflected out of the way the only remaining obstacle in the route to the shoulder is the subscapularis muscle, which in its lateral 2.5 centimetres or so is tendinous. It lies closely upon the anterior capsule of the shoulder and is often partly blended with it. Before the tendon is divided it is important to define its superior and inferior borders. This is done most easily if the muscle is put on the stretch by lateral rotation of the humerus. While an assistant holds the arm in this position the surgeon frees the borders of the subscapularis from adjacent flimsy areolar tissue and passes a blunt-pointed bone lever behind the tendon from above downwards. To prevent retraction of the muscle belly of subscapularis out of sight when the tendon is divided, holding sutures of strong catgut or silk are inserted proximal to the proposed line of division. The subscapularis tendon is then divided about 2.5 centimetres proximal to its insertion into the humerus. The proximal (muscular) part of the subscapularis retracts out of the way: the distal part may be retracted laterally with slender hooks or with a holding stitch. The anterior part of the capsule of the shoulder joint is thus exposed: indeed it is often opened when the subscapularis is divided because the subscapularis tendon may be so closely blended with the capsule that the two are divided together. If the capsule has not already been opened it is incised vertically to whatever extent may be required. Retraction of the capsular flaps exposes the front of the head of the humerus and the anterior rim of the glenoid fossa.

Closure. Depending upon the nature of the operation to be performed on the shoulder, the capsule may be closed by interrupted sutures or in special circumstances it may be sutured with overlap (see Putti-Platt operation, page 140). Likewise the subscapularis tendon may be repaired end-to-end or overlapped, as circumstances demand. The next step in the closure is to approximate the tip of the coracoid process to the base. Usually, adequate fixation is attained by sutures through the soft tissues on either side of the bone, but some surgeons prefer to fix it with a screw. Finally the upper edge of the deltoid muscle is reattached to the fringe that remains on the clavicle, and the contiguous edges of deltoid and pectoralis major are tacked together lightly with interrupted catgut sutures. Nearly always the skin may be closed without drainage.

Comment

The anterior approach to the shoulder is simple and gives good access to the front of the joint. Unless the anatomy has been grossly distorted, as for instance by long-standing dislocation of the shoulder, it does not endanger important blood vessels or nerves, with the possible exception of the musculocutaneous nerve as already mentioned.

In most centres this is the standard approach for stabilisation of the shoulder in recurrent anterior dislocation and for other operations on the front of the joint. It has the disadvantage that the scar often becomes broad and prominent. This matters little in men but may be a disturbing blemish in young women: so much so that in such patients the axillary approach may be considered as an alternative (see below).

ANTERIOR AXILLARY APPROACH TO SHOULDER

An anterior axillary incision has been used for exposure of the shoulder because it is less likely than the delto-pectoral incision to leave an ugly scar. The method to be described is that of Leslie and Ryan (1962).

TECHNIQUE

Position of patient. The patient lies supine with the upper limb upon a side table. The shoulder is abducted 90 degrees and laterally rotated.

Incision. The incision is vertical. It crosses the mid-point of the anterior axillary fold and is carried 6 or 7 centimetres posteriorly into the axilla.

The deep dissection. The skin and fascia are undermined widely in a proximal direction so that the skin edges may be easily retracted upwards and laterally. The cephalic vein, marking the delto-pectoral groove, is thus brought into view, and the interval between deltoid and pectoralis major is opened up by blunt dissection. The vein is retracted laterally with the deltoid muscle. In the medial part of the wound the pectoralis major is retracted downwards and medially: to gain sufficient access it may be necessary to separate the tendon of the muscle partly or completely from its insertion on the humerus. The subsequent stages of the exposure follow those of the standard delto-pectoral approach: they consist in distal reflection of the conjoined coracobrachialis and short head of biceps and division of the subjacent subscapularis close to its musculo-tendinous junction.

Closure. If the tendon of pectoralis major has been divided it must be repaired carefully with interrupted sutures. After repair of the subscapularis and coracobrachialis and biceps (or coracoid process) the muscles fall into place and only a few light absorbable sutures are needed to approximate the deltoid and pectoralis major. The skin edges may be drawn together by a subcuticular suture in order that the scar may be as unobtrusive as possible.